PROVIDENCE
Children's Health

Pediatric Hernias

"Hernias, hernias everywhere - what to do about them?"

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Conflicts of interest

- Planning Committee & Faculty Disclosure: The Planning Committee and Faculty have no relevant financial relationships with commercial interests to disclose.

Goals/Questions

- What are the types of pediatric hernias, and how common are each?
- Which pediatric hernias should be referred and when?
- What the concerns with each type of hernia?
- How are pediatric hernias repaired?
- What are long-term concerns and expectations?

Inguinal Hernia

- History
  - Greek, Hellenistic (323-31 BC) terracotta figures[1]
    - Treatment radical excision[2,3]
  - Ramses V (1156-1152 BC), mummy with hernia sac[4]
  - 900 BC: Phoenician statue with tight fitting bandages

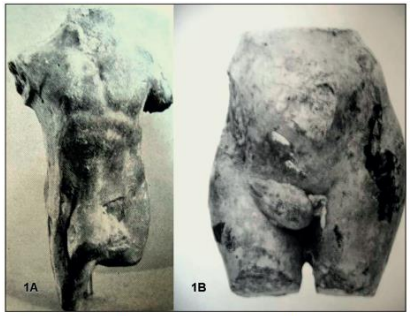


Fig. 1. A. Male terracotta figurine, Paris, Louvre Museum, D 1206. **B:** Female terracotta figurine, Jena, Friedrich-Schiller-Universitä, Institut für Geschichte der Medizin, Naturwissenschaft und Technik, Ernst-Haeckel-Haus, V 27.

Inguinal Hernia

- Galen (200 AD)[5] & Paul of Aegina (700 AD)[6] described IH as well
  - Paul recommended ligature of the hernia sac with amputation of the testicle[7]; regression in treatment
- Albucasis (1013-1106 AD) removed testicle during hernia surgery[8]
- William of Salicet (1210-1277 AD) rejected removal of testicle. Described reduction in Trendelenburg[9]

Inguinal Hernia

- Ambroise Pare included an entire chapter on hernias in *The Apologie and Treatise*. Described hernia reduction and closure of peritoneum. Strongly recommended against castration[10]
- Kaspar Stromayr distinguished between direct and indirect hernias (1559 AD)
- Hasselbech describes eponymous triangle and iliopubic tract (1814 AD)

Inguinal Hernia

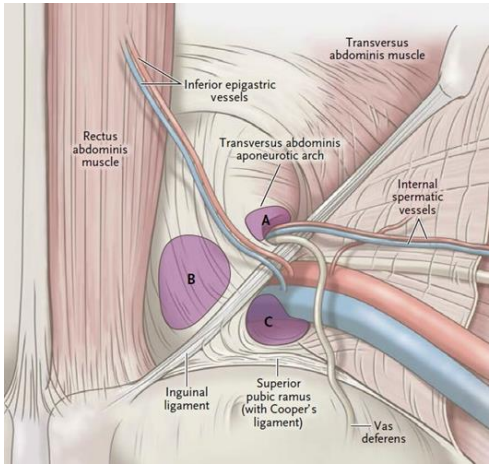
- **1870/1871: Lister introduces antiseptic surgery**
- **1876: Czerny describes high ligation of the sac**
- **1881: Lucas-Championniere splits the external oblique and imbricates the hernia floor**
- 1896: Halsted introduces gloves
- Mortality remains high, 2-7%; and recurrence near 100%
- **Bassini sutures transversus abdominus and external oblique to inguinal ligament[11-13]**

Inguinal Hernia

- Background
  - Most common elective pediatric surgical procedure
  - **Right 2x > Left**
  - More common in **premature infants**
  - Associated with undescended testicle, abdominal wall defect, connective tissue disease
  - Failure of obliteration of processus vaginalis (testicle, round ligament)

Inguinal Hernia

- Direct inguinal hernia bulges through floor medial to inferior epigastric vessels, while **indirect hernia bulges lateral to inferior epigastric vessels**



Inguinal Hernia

- Presentation
  - Asymptomatic or asymptomatic **groin swelling that may extend to scrotum or labia**
  - **Crying or straining makes more prominent**
  - Fortunately, **most are asymptomatic**
  - Rarely, present with incarceration, obstruction or strangulation

Inguinal Hernia

- *Examination Tips!*
  - Stand on contralateral side, palpating along inguinal canal at external ring
  - **Valsalva maneuvers** (coughing, sit-ups)
  - Although subtle, a thickened cord (silk glove sign) suggests presence of hernia sac
  - Examine for undescended testicles (UDT)
  - **Home pictures at end of day**

Inguinal Hernia

- Diagnosis
  - **Physical examination is nearly always all that is needed**
  - US if cannot distinguish between hernia and hydrocele, or in rare cases, lymph node
  - Transillumination!

Inguinal Hernia

- **Incarcerated hernias** cannot be reduced. **More common in infants**.
  - **Almost always be reduced with proper technique**
    - Straightening canal, **constant**, **directed pressure**
    - **Trendelenburg position**, pain medication and sedation can help
  - If reduced, should be repaired semi-urgently/electively
  - If failed reduction, immediate surgery

Inguinal Hernia

- Surgery
  - **Do NOT heal spontaneously**
  - **Must be repaired due to risk of incarceration** (17% right, 7% left)
    - Elective repair – 11% ED visit by 30 days after dx (ED utilization, HC resources, parental concern)
    - **50% of incarcerations in first 6 months of life**, 2/3 in children <1 year

Inguinal Hernia

- If asymptomatic, parents do not need to reduce hernia, but **should be educated on how to do so, and counseled on signs/symptoms of incarceration**

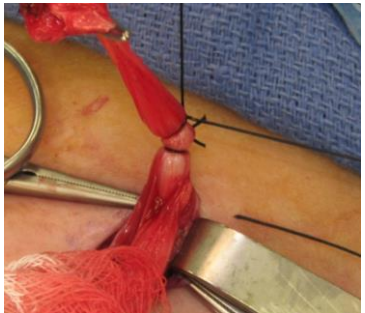
Inguinal Hernia

- *Timing* (AAP Section on Surgery)
  - NICU: 63% repair before discharge, 18% at specific corrected age, 5% when convenient
  - Outpatient: 53% repair when convenient, 27% wait until between 38-60 cGA (mean 53.1 weeks)
- **Risk of apnea in premature babies**
  - 5% at 48 weeks cGA, 1% at 54 weeks cGA
  - Need 12-24 (preferred) inpatient monitoring earlier

Inguinal Hernia

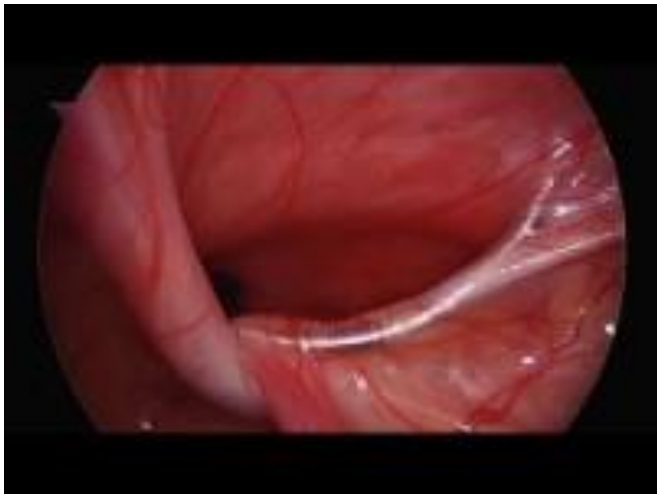
- Operative repair
  - Open
    - **High ligation of hernia sac**
    - Consider reconstruction of inguinal floor, Bassini repair if weakened





Inguinal Hernia

- Operative repair
  - Laparoscopic
    - **High ligation of hernia sac without excision**
    - Modern studies suggest similar hernia recurrence as with open repair



Inguinal Hernia

- Complications
  - Testicular atrophy (1-2%), vas deferens injury (<2%), wound infection (<1%), recurrence (1-5%)

- Follow-up
  - 1 office, phone or televisit
  - 6 months, examine testicles for iatrogenic UDT which would require orchiopexy

Umbilical Hernia

- Background
  - Common
  - Gender ratio equal
  - May be more common in African-Americans
  - Increased in Beckwith-Wiedemann syndrome, trisomies 13, 18 and 21

Umbilical Hernia

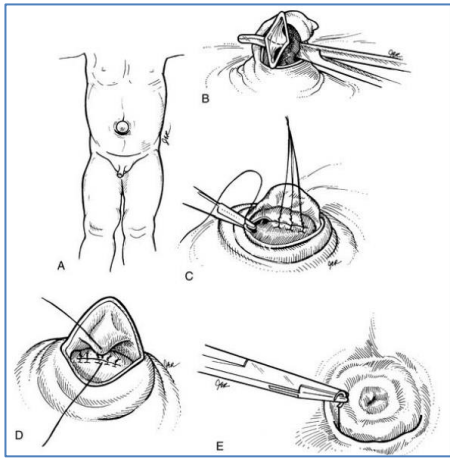
- Presentation
  - Asymptomatic **bulge that increases with valsalva**
  - Symptoms are rare
  - **Obstruction is extremely rare/nearly non-existent**
  - No medical treatment (binders/taping are historical interest only)

Umbilical Hernia

- Surgery
  - Smaller (<1 cm) more likely to close than >1.5 cm
  - No large population studies
  - **Most close at 4-5 years of age, 85-90%**
    - Theory that transition from abdominal wall to diaphragmatic breathing at this age may contribute
  - **Symptomatic repair at time of diagnosis**
  - **Should repair, will enlarge, risk of complications**

Umbilical Hernia

- Operative repair
  - Curvilinear incision below umbilicus or vertical through umbilicus
  - Separation of hernia sac from umbilical skin
  - Fascia closed with interrupted absorbable sutures



Umbilical Hernia

- Complications
  - Bleeding, infection and recurrence are rare, all ~2%
  - Injury to viscera during repair is very rare

- Follow-up
  - Routine follow-up is offered but not essential
  - Telephone/televisit is reasonable

Epigastric Hernia

- Background
  - Hernia through **midline**/linea alba, **between xiphoid and umbilicus**
  - **Small mass, usually with incarcerated preperitoneal fat**
  - Different than diastasis recti

Epigastric Hernia

- Presentation
  - **More often symptomatic**, with intermittent pain
  - **Midline, epigastric bulge**
  - May be adjacent to umbilicus and thus difficult to distinguish from umbilical hernia
  - Congenital, defect in anterior fascia; **only preperitoneal fat**. Very rarely full thickness, thus almost never incarcerated viscera

Epigastric Hernia

- Surgery
  - Should be repaired because they **do not resolve**

- Operative repair
  - Mark beforehand! Hard to find when anesthetized
  - If concern for umbilical hernia as well, supraumbilical curvilinear incision permits repair of both
  - Preperitoneal fat excised or reduced, hernia closed

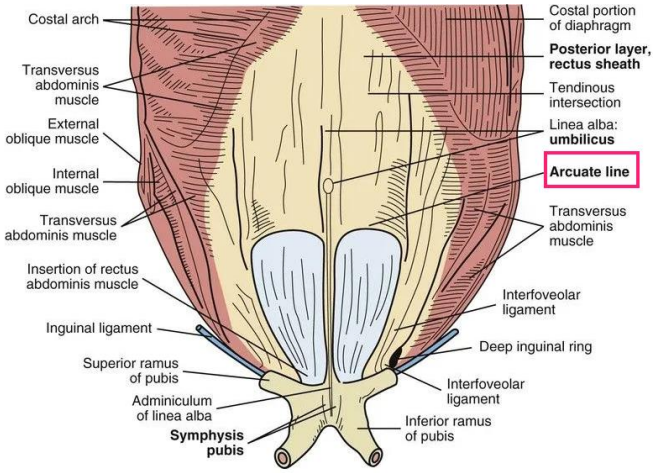
Epigastric Hernia

- Complications
  - Bleeding, infection rare
  - Recurrence very rare

- Follow-up
  - Routine follow-up is offered but not essential
  - Telephone/televisit is reasonable

Spigelian Hernia

- Background
  - Defect at junction of rectus abdominus and aponeurosis of the internal oblique at the linea semiluminaris
  - Inferior to arcuate line, where there is no posterior sheath
  - Associated with skeletal anomalies



Spigelian Hernia

- Presentation
  - **Pain or a bulge at the lateral border of the rectus muscle, beneath the umbilicus**
  - Because the defect is posterior sheath, a **bulge may not be obvious**, even with incarceration
  - **US or CT can be very useful**

Spigelian Hernia

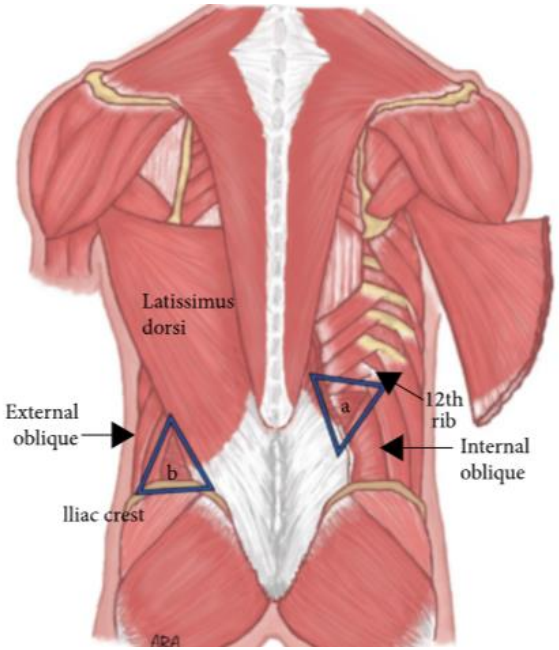
- Surgery
  - Should be repaired because they **do not resolve, can become incarcerated**

- Operative repair
  - Transverse incision over defect with excision of sac and closure of defect
  - Mesh may be needed in larger defects

Lumbar Hernia

- Background
  - Congenital, very rare

- Presentation
  - Bulge in area bordered by 12th rib, sacrospinalis muscle, internal oblique
  - Typically contain **preperitoneal fat**
  - **Soft mass**



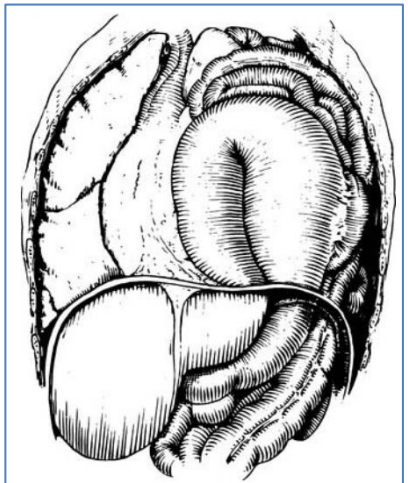
Lumbar Hernia

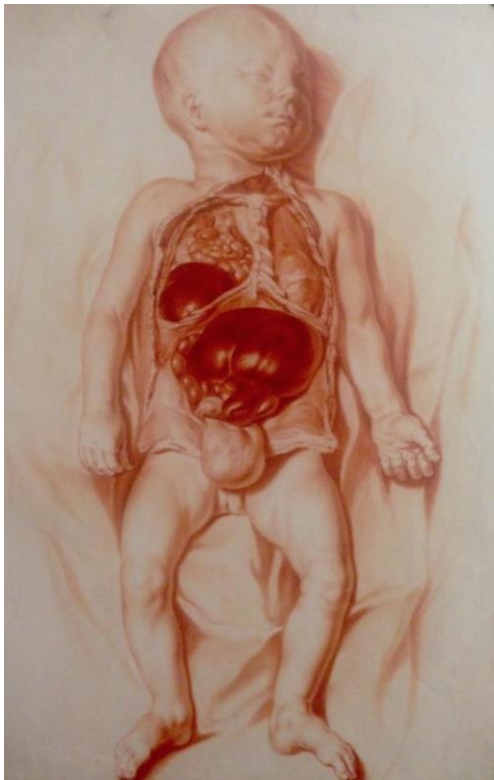
- Surgery
  - Advised because **will not resolve** and **incarceration is theoretically possible**

- Operative repair
  - Primary closure. Prosthetic mesh may be needed because the tissue is often weak or absent when adjacent to bone
    - Absorbable mesh in children, decrease risk of scoliosis

Diaphragmatic Hernia

- History
  - First language description in 1754 by McCauley





Diaphragmatic Hernia

- 1827: Cooper; 1834: Laennec both describe CDH
- Bochdalek (1801-1883) speculates hernia results from rupture of membrane separating the pleuroperitoneal cavity into 2 cavities
- 1888: Naumann; 1890: O'Dwyer make first efforts to repair
- 1901: Aue, first successful repair in adult
- 1905: Heidenhaim, first successful repair in child
- Hedblom's review shows that 75% of 44 infants died

Diaphragmatic Hernia

- 1940: Ladd and Gross show consistent, successful repair (9/16 patients)

Diagphragmatic Hernia

- Background
  - Incidence around 1/200
    - True incidence likely underestimated due to spontaneous or elective abortion
  - **1/3 die as stillbirth**, often with other severe anomalies
  - **80% left sided**
  - **90% posterolateral "Bochdalek"**; 10% anterior "Morgagni"

Diagphragmatic Hernia

- Background
  - *Cardiopulmonary disease*
    - **Pulmonary hypoplasia**, with underdeveloped airways, decreased lung weight, decreased number of bronchioles and overall bronchiole cross-sectional area, alveolar count and volume
    - Pulmonary vascularization is abnormal, with resulting **pulmonary hypertension**

Diagphragmatic Hernia

- Diagnosis
  - **Prenatal US**, most can be seen in 2nd trimester
    - **Polyhydramnios**, **bowel within chest**, MS shift
    - **Lung:head ratio (LHR) predicts survival**
      - LHR >1.35 100%; 1.35-0.5, 61%; <0.6, no survival
      - LHR should be calculated as observed/expected as the normal ratio changes during gestation
  - Fetal MRI great for morphologic, volumetric measurements

Diagphragmatic Hernia

- Presentation
  - **Respiratory distress is typical**
    - Tachypnea, chest wall retractions, grunting, cyanosis, pallor
    - Scaphoid abdomen
    - CXR confirms bowel within chest

Diagphragmatic Hernia

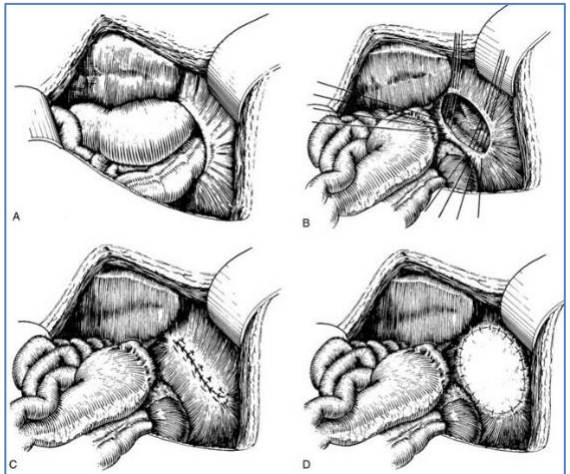
- Management
  - Endotracheal intubation, severe cases (some intubate all)
  - **Orogastric decompression**
  - **Aggressive resuscitation, targeting preductal SaO2 85-95% (cerebral!)** with permissive hypercapnea to maintain low PIP
  - ECMO may be needed. CDH accounts for 25% of all infants needing ECMO

Diagphragmatic Hernia

- Surgery
  - Historically performed emergently
  - We now understand that the **defect itself is not the issue**, but the **resulting pulmonary hypoplasia and pHTN. Immediate procedures prior to stabilization can exacerbate pHTN and hypoxemia beyond medical correction**, resulting in death

Diagphragmatic Hernia

- Operative repair
  - Open or minimally invasive from either abdomen or chest
  - Patch may be needed for larger defects



Late-Presenting Diagphragmatic Hernia

- **Most often discovered due to non-specific GI or respiratory symptoms** prompting work-up
- Complications rare, prognosis favorable
- **Symptomatic should be repaired immediately**
- **Asymptomatic, most would repair electively** – some would not repair if small and no digestive tract herniation
- Small, right sided defects can avoid repair entirely if covered by liver, especially in high-risk patients

Take Home Points

- Inguinal hernia
  - Common. Should be repaired due to the risk of incarceration
  - Outpatient repair should be delayed until 54-60 weeks cGA due to anesthetic risks
  - Open and laparoscopic repairs have similar recurrence
  - Follow-up should focus on testicle location and characteristics in boys

Take Home Points

- Umbilical hernia
  - Do not need to be repaired until age 4-5 in the absence of symptoms due to the high rate of spontaneous closure.
  - Incarceration is very rare.
- Epigastric hernia
  - Should be repaired because they do not resolve and are often symptomatic

Take Home Points

- Spigelian hernia
  - Very rare
  - Found lateral to rectus muscles and below umbilicus
  - Most present with symptoms at some point, and should be repaired
- Lumbar hernia
  - Very rare
  - Should be repaired due to risk of incarceration

Take Home Points

- Diaphragmatic hernia
  - Diagnosed prenatally with US and MRI
  - LHR predicts survival
  - Morbidity and mortality related to pulmonary hypoplasia and pulmonary hypertension
  - Repair in neonatal period when diagnosed
  - Timing of repair of late-presenting CDH should be individualized base on symptoms, risk, and size

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Questions?

- Phone number: 503-216-6050
- Fax: 971-282-0102
- Epic code for internal referrals: St. Vincent - REF84BB; Clackamas - REF84H